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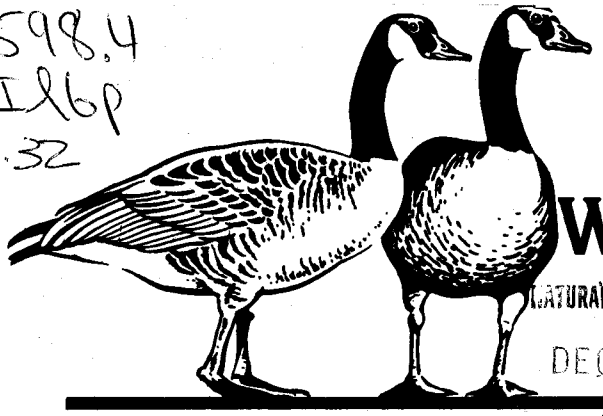

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WATERFOWL PROGRAM

ILLINOIS DEPARTMENT OF CONSERVATION
DIVISION OF FISH AND WILDLIFE RESOURCES

EFFECTIVENESS OF SELECTED 12 GAUGE SHELLS FOR DISPATCHING CRIPPLED DUCKS

William L. Anderson, Illinois Department of Conservation, Champaign, IL 61820

William F. Nichols, Nichols Net & Twine, East St. Louis, IL 62280*

Abstract: Shotgun shells (2 3/4-inch 12 gauge) loaded with 1-1/8 oz lead #8, 1-14/ oz lead #6, 1-1/8 oz steel #6, or 1-1/8 oz steel #4 shot were tested for their effectiveness for dispatching crippled ducks on aquatic habitats in Illinois in 1978, 1979, and 1980. Participating hunters fired 1,312 shells (mean range = 32.6 to 35.6 yards) at 787 cripples, 682 of which were successfully retrieved. Retrieval rates were 89.2% for lead #8, 88.6% for lead #6, 83.6% for steel #6, and 86.0% for steel #4. The four test shells exhibited similar abilities in dispatching crippled mallards and other dabbling ducks, but lead #6 and steel #6 did not perform well on diving ducks. Lead #6 delivered the best performance at short range (mean = 26.0 to 28.2 yards) and a poor performance at long range (mean - 41.6 to 45.3 yards). Steel #6 also performed poorly, compared to lead #8 and steel #4, at long range.

Experienced waterfowl hunters are acutely aware of the need for quickly dispatching crippled ducks that have been knocked down over aquatic habitats. Cripples not so attended often regain equilibrium within a few seconds--some never lose it--and elude capture by diving or by swimming away. Factors that influence crippling losses are species of duck, type of habitat, use of a dog, competition between hunters, and the skill of the individual hunter (Bellrose 1953:338). Crippling losses in the United States average 18 percent of all

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*Retired

waterfowl knocked down or 22 birds lost per 100 birds retrieved (U.S. Fish & Wildlife Service 1976:45).

In a survey conducted in 1979, hunters indicated that the "typical" shotgun shell used for taking ducks in Illinois is a standard-quality 2 3/4-inch 12 gauge loaded with 1-1/4 oz of unbuffered lead #4 shot (Anderson 1980). 49% of the hunters (all gauges combined) use #4 shot and another 26% use #6 shot. 27% of the hunters with 12 gauge shells (2 3/4-inch and 3-inch combined) use small shot (#7-1/2, #8, or #9) for dispatching crippled ducks. These people believe that a charge of many small shot is more apt to place one or more pellets in a vital area (head or neck) of a low-floating cripple than is a heavy charge of #4 or #6 shot. However, steel shot, which is now being used on many important waterfowl areas, is currently available only in large shot sizes (BB, #1, #2, and #4) and therefore could be inefficient in dispatching crippled ducks. Thus, the purpose of this study was to evaluate the effectiveness of steel shot relative to lead shot, and small shot sizes relative to large shot sizes, for dispatching crippled waterfowl (primarily ducks) after they have been knocked down over aquatic habitats.

Acknowledgement is made to the many Illinois Department of Conservation personnel, Illinois Natural History Survey personnel, and private citizens for collecting data. Tom Roster, Ballistics Specialist for the U.S. Fish & Wildlife Service, offered advice on technical aspects of the testing. Richard E. Warner, Illinois Natural History Survey, did the computer programming. Appreciation is also extended to Federal Cartridge Corporation, Minneapolis, Minnesota, for special loading shells with steel #6 shot. This investigation was financed in part with research grants from the U.S. Fish & Wildlife Service's Office of Migratory Bird Management, Washington, D.C., and Max McGraw Wildlife Foundation, Dundee, IL.

METHODS AND MATERIALS

The shotgun shells tested in 1978 were 2 3/4-inch 12 gauge loaded with 1-1/8 oz lead #8 shot or 1-1/8 oz steel #4 shot. These shells were obtained directly from Remington Arms Company, Bridgeport, Connecticut in October 1978. The lead #8 shells were standard Remington Shurshot, which contained 449 pellets (mean of 10 shells) and had a nominal velocity of 1,255 fps; their patterning performance was 53.8% (241 pellets) in a 30-inch circle at 40 yards using a 30-inch, full choke barrel (Table 1). The steel #4 shells contained 215 pellets (mean of 10 shells), had a nominal velocity of 1,365 fps, and patterned at 67.3% (145 pellets).

In 1979, the two shells described above plus two additional 2 3/4-inch 12 gauge shells were used in the testing. The latter included Remington Express shells that were purchased from Frank's Sport Shop in Decatur, Illinois in October 1979. These shells were loaded with 1-1/4 oz lead #6 shot, contained an average of 286 pellets (mean of 10 shells), had a nominal velocity of 1,330 fps, and patterned at 55.6% (159 pellets) with the procedures described above (Table 1). The other shell was purchased from Federal Cartridge Corporation, Minneapolis, Minnesota in August 1979 and was loaded with 1-1/8 oz steel #6 shot. These shells contained an average of 354 pellets (mean of 10 shells), had a measured velocity of 1,329 fps, and patterned at 77.7% (275 pellets).

Testing of the lead #6 and steel #6 shells (plus small numbers of the lead #8's and steel #4's) was continued in 1980. In addition, a fifth shell (1-1/4 oz lead #4 with nominal velocity of 1,330 fps) was selected for inclusion in the testing. Findings for this shell will be reported after additional data are obtained during the 1981 hunting season.

Wildlife biologists and refuge managers of the Illinois Department of Conservation, research biologists of the Illinois Natural History Survey, and

private citizens were contacted in September of each year to (1) inform them that this study was planned for the approaching duck season, (2) determine how many of them would be willing to use the test shells (provided free) and record data during the course of their normal waterfowl hunting activities, and (3) if willing, how many shells of each type they could reasonably use in one season. Cooperators were subsequently sent packets that contained (1) some (usually 10-25) shotgun shells of each type they specified, (2) printed cards on which to record data, and (3) a sheet of instructions. The instructions specified that the shells should be used in the same manner as any other shotgun shell for dispatching crippled birds, the resulting data should be recorded on the cards provided, a separate card should be used for each bird, and the cards should be returned to the senior author following the hunting season. Pertinent information requested included water conditions, species of bird, number of shells fired, range (distance) of each shot, and whether the bird was retrieved (Fig. 1).

The data were analyzed with the University of Illinois' Cyber 175 Computer System, located at Champaign. Differences among the shell types were tested for significance ($P < 0.05$) with Student's t. Variance was calculated for percentages and ratios with the formula pq/n (Cochran 1963:52).

RESULTS

During the 3 years, 207 hunters (counting repeaters) participated in the study and were issued 8,710 shells (1,480 lead #8, 2,580 lead #6, 2,220 steel #6, and 2,430 steel #4). Of these hunters, 136 (66%) provided usable data, which were generated by firing 1,312 shells at 787 ducks. An additional 86 shells were fired at geese or coots, which increased the number of shells that produced usable data to 1,398 or 16% of the total issued. Unusable data were received for another 135 shells that were fired at 67 cripples. The 787 crippled

ducks that were shot at included 339 (43%) mallards and black ducks, 242 (31%) other dabbling ducks, 178 (23%) diving ducks, and 28 (3%) unidentified ducks.

Efficiency of the four shell types relative to species and groups of ducks are summarized in Table 2. Mean range was 31.9 to 37.4 yards for mallards and black ducks, 29.7 to 33.1 yards for other dabbling ducks, 31.6 to 36.1 for diving ducks, and 32.6 to 35.6 for all ducks. The differences between lead #8 and steel #6, lead #6 and steel #4, and steel #6 and steel #4, for mallards and black ducks were statistically significant. For other dabbling ducks, mean range for lead #6 differed significantly from mean ranges for the other shells. For diving ducks, the difference between lead #8 and lead #6 was significant. For all ducks, mean range for steel #4 was significantly different from mean ranges for the other shells.

The number of shells fired per crippled duck (all species) retrieved averaged 1.79 for lead #8, 1.91 for lead #6, 2.02 for steel #6, and 1.95 for steel #4 (Table 2). None of the differences among these values were statistically significant. However, the ratios of shells fired per crippled diving duck retrieved were significantly less for lead #8 and steel #4 than for lead #6 and steel #6.

The percentage of shot-at cripples (all species) that were successfully retrieved were 89.2 for lead #8, 88.6 for lead #6, 83.6 for steel #6, and 86.0 for steel #4 (Table 2). None of the differences among these values were statistically significant. However, a significant difference did occur between lead #8 (88.0%) and steel #6 (64.3%) for diving ducks.

Efficiency of the four shell types for dispatching crippled ducks (all species) relative to range are presented in Table 3. At short range (mean 26.0 to 28.2 yards), the number of shells fired per crippled duck retrieved averaged 1.73 for lead #8, 1.59 for lead #6, 1.75 for steel #6, and 2.00 for steel #4. The difference between lead #6 and steel #4 was statistically significant. Percentage of crippled ducks successfully retrieved varied from

98.4 for lead #6 to 88.9 for steel #4--a difference that was significant. The difference between lead #6 and steel #6 was also significant.

At long range (mean 41.6 to 45.3 yards), the number of shells fired per crippled duck retrieved averaged 1.90 for lead #8, 2.65 for lead #6, 2.69 for steel #6, and 1.90 for steel #4 (Table 3). The values for lead #8 and steel #4 were significantly less than those for lead #6 and steel #6. Retrieval rates were 82.3% for lead #8, 72.0% for lead #6, 73.1% for steel #6, and 82.2% for steel #4. None of the differences among these percentages were statistically significant.

The small amount of data obtained on the efficiency of the four shotgun shells for dispatching crippled geese and coots is summarized in Table 4.

DISCUSSION

This study was designed to test the relative effectiveness of lead #8, lead #6, steel #6, and steel #4 shot for dispatching crippled ducks. It did not take into consideration knocked-down birds that were not searched for or retrieving attempts in which no shells were fired. Thus, the findings are not representative of total crippling losses for duck hunting in Illinois. Also, the findings are tempered by the fact that mean ranges at which the four test shells were used frequently differed significantly (Tables 2 and 3). Finally, this is an ongoing project and, as such, the conclusions presented herein are regarded as tentative.

The two steel shells (#6 and #4) did not differ significantly from the two lead shells (#8 and #6) in effectiveness for dispatching crippled mallards and other dabbling ducks (Table 2). However, a statistically significant difference did exist between steel #6 and lead #8 in their abilities to reduce diving ducks to the bag--retrieval rates were 64.3% and 88.0%, respectively. Also, in terms of number of shells fired per diver retrieved, steel #6 was

significantly less efficient than lead #8 and steel #4 was significantly more efficient than lead #6. Thus, it appears that the two steel shells and the two lead shells performed similarly on crippled dabbling ducks and dissimilarly on crippled diving ducks.

At short range (1 or more shots fired at <35 yards with means of 26.0 to 28.2 yards), the lead #6 shells were superior to the two steel loads for dispatching crippled ducks. With one exception, the differences were statistically significant (Table 3). In addition, the relatively large lead #6 shot may have outperformed the smaller lead #8 shot in dispatching cripples at short range.

At long range (all shots fired at $\geq$35 yards with means of 41.6 to 45.3 yards), lead #8 and steel #4 delivered almost identical performances that were superior to the other two shells. The differences for number of shells fired per cripple retrieved were statistically significant (Table 3). Thus, the relatively small lead #8 shot was superior to the larger lead #6 shot for dispatching crippled ducks at long range. The opposite was true for steel shot--i.e., the relatively large steel #4 outperformed the smaller steel #6 at long range. It is noteworthy that the shells loaded with #6 shot--whether lead or steel--did not perform well at long range. It is also interesting that the 1-1/4 oz lead #6, a popular duck load, was the best performing shell at short range and a poor performing shell at long range.

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Table 1. Patterning performance of 2 3/4-inch 12 gauge shells tested for efficiency for dispatching crippled waterfowl that had been knocked down over aquatic habitats in Illinois in 1978, 1979 and 1980. The patterns were determined by firing 10 shells of each type at each distance and counting the number of pellets registering inside a 10-, 20-, and 30-inch diameter circle drawn around densest portion of pattern. The pattern testing was conducted at Urbana, Illinois, in mean temperature of 70°F, at 700 feet elevation, under no-wind conditions, through 30-inch full choke barrel.

Type of Shot	Diameter of Circle		
	10 Inches	20 Inches	30 Inches
	30 YARDS		
Lead #8	105	280	390 (86.9%)*
Lead #6	60	162	234 (81.8%)
Steel #6	97	246	327 (92.4%)
Steel #4	64	147	189 (88.7%)
	40 YARDS		
Lead #8	43	141	241 (53.8%)
Lead #6	26	92	159 (55.6%)
Steel #6	63	179	275 (77.7%)
Steel #4	30	90	145 (67.3%)

*The percentage is based on the mean number of pellets registering inside the 30-inch circle divided by the mean number of pellets found in 10 shells of the type being tested.

Table 2. Efficiency of lead #8, lead #6, steel #6, and steel #4 shot in 2 3/4-inch 12 gauge shells for dispatching crippled ducks that had been knocked down over aquatic habitats in Illinois in 1978, 1979, and 1980. Paired values with the same superscript differ significantly ($P < 0.05$).

Species and Type of Shot	Mean ± SE Range in Yards	Number of Ducks		Number of Shells Fired		Percent of Ducks that Were Retrieved
		Shot At	Retrieved	Total	Per Duck Retrieved	
Mallard & Black Duck						
Lead #8	34.8 ± 1.2[a]	54	48	79	1.65	88.9
Lead #6	33.6 ± 1.2[b]	86	79	126	1.60	91.9
Steel #6	31.9 ± 0.8[a,c]	83	72	125	1.74	86.8
Steel #4	37.4 ± 1.0[b,c]	116	100	199	1.99	86.2
Other Dabbling Ducks*						
Lead #8	33.1 ± 1.4[a]	42	39	62	1.59	92.9
Lead #6	29.7 ± 1.2[a,b,c]	63	56	95	1.70	88.9
Steel #6	33.1 ± 1.0[b]	71	65	129	1.99	91.6
Steel #4	33.1 ± 1.0[c]	66	59	113	1.92	89.4
Diving Ducks**						
Lead #8	31.6 ± 1.0[a]	50	44	92	2.09[a,b]	88.0[a]
Lead #6	36.1 ± 1.2[a]	48	39	112	2.87[a,c]	81.3
Steel #6	33.1 ± 1.4	42	27	79	2.93[b,d]	64.3[a]
Steel #4	35.3 ± 1.7	38	30	58	1.93[c,d]	78.9
Unidentified Ducks						
Lead #8		2	1	3		
Lead #6		5	5	9		
Steel #6		5	4	6		
Steel #4	34.8 ± 1.8	16	14	25	1.79	87.5
All Ducks						
Lead #8	33.3 ± 0.7[a]	148	132	236	1.79	89.2
Lead #6	33.5 ± 0.6[b]	202	179	342	1.91	88.6
Steel #6	32.6 ± 0.8[c]	201	168	339	2.02	83.6
Steel #4	35.6 ± 0.7[a,b,c]	236	203	395	1.95	86.0

*Included the following species in descending order of abundance: green-winged teal (28%), wood duck (25%), gadwall, widgeon, pintail, blue-winged teal, and shoveler.

**Included the following species in descending order of abundance: scaup (59%), ring-necked duck (17%), bufflehead, redhead, canvasback, mergansers, goldeneye, and old squaw.

Table 3. Efficiency of lead #8, lead #6, steel #6, and steel #4 shot in 2 3/4-inch 12 gauge shells for dispatching crippled ducks at short and long range. The ducks had been knocked down over aquatic habitats in Illinois in 1978, 1979, and 1980. "Short range" includes attempts in which 1 or more shots were taken at <35 yards, whereas "long range" includes attempts in which all shots were taken at ≥35 yards. Paired values with the same superscript differ significantly ($P < 0.05$).

Range and Type of Shot	Mean ± SE Range in Yards	Number of Ducks		Number of Shells Fired		Percent of Ducks that Were Retrieved
		Shot At	Retrieved	Total	Per Duck Retrieved	
Short Range						
Lead #8	27.5 ± 0.6	83	78	135	1.73	94.0
Lead #6	26.0 ± 0.5[a]	127	125	199	1.59[a]	98.4[a,b]
Steel #6	26.9 ± 0.5	133	119	208	1.75	89.5[a]
Steel #4	28.2 ± 0.5[a]	117	104	208	2.00[a]	88.9[b]
Long Range						
Lead #8	41.6 ± 0.7[a,b]	62	51	97	1.90[a,b]	82.3
Lead #6	43.8 ± 0.8[a]	75	54	143	2.65[a,c]	72.0
Steel #6	42.1 ± 0.6[c]	67	49	132	2.69[b,d]	73.1
Steel #4	45.3 ± 1.0[b,c]	107	88	167	1.90[c,d]	82.2

Table 4. Efficiency of lead #8, lead #6, steel #6, and steel #4 shot in 2 3/4-inch 12 gauge shells for dispatching crippled geese and coots that had been knocked down over aquatic habitats in Illinois in 1978, 1979, and 1980.

Species and Type of Shot	Mean ± SE Range in Yards	Number of Birds		Number of Shells Fired		Percent of Birds that Were Retrieved
		Shot At	Retrieved	Total	Per Bird Retrieved	
Geese*						
Lead #8		4	4	7		
Lead #6		5	5	6		
Steel #6		16	16	24	1.50	100
Steel #4		17	16	25	1.56	94.1
American Coot						
Lead #8		3	2	3		
Lead #6		0	0	0		
Steel #6		3	2	3		
Steel #4		14	11	18	1.64	78.6

*Primarily Canada geese.

EFFICIENCY OF SHOTGUN SHELLS FOR
DISPATCHING CRIPPLED WATERFOWL

(fill out separate card for each bird)

DATE_____ Area_____ Observer_____

Water conditions (circle one)...Smooth...Ripples...Waves...White Caps

Species of Waterfowl_____

Number of shells fired (circle one) ... 1 2 3 4 5 6

Estimated distance (yards) of EACH shot ___ ___ ___ ___ ___ ___

Did you retrieve bird (circle one) ..... YES ..... NO .....

Type of shot used (circle one)
...Steel #4....Steel #6....Lead #4....Lead #6....Lead #8...

RETURN TO:

Bill Anderson
Ill. Dept. Cons.
172 Nat. Res. Bldg.
Urbana, IL 61801

Comments:_____

Figure 1. The printed data card (actual size) used for recording information on the effectiveness of selected 12 gauge shells for dispatching crippled waterfowl in Illinois in 1980. Similar cards were used in 1978 and 1979.

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